III.—EXPERIMENTS ILLUSTRATIVE OF COMBUSTION PHENOMENA

A. *Burning Oxygen in Sulphur Vapour.*—A two-necked balloon is fitted with corks, each carrying a tube, one of which passes towards the bottom of the balloon, and has its tip slightly bent upwards, the other, beginning flush with the inner surface of the cork, passes downwards into a cylinder containing water. The first of these tubes communicates, by means of a long piece of caoutchouc tubing, with a supply of dry oxygen. About 40 to 50 grams of dry sulphur are placed in the balloon, and heated till the vessel is quite filled with reddish vapours, the oxygen delivery tube being meanwhile withdrawn. Oxygen is allowed to flow from the delivery tube in a stream sufficiently rapid to cause a glowing chip of wood held 2 to 3 millims. from the end of the tube to burst into flame; a small piece of charcoal is attached by platinum wire to the tip of the oxygen delivery tube; the charcoal is ignited, and the cork carrying the tube which delivers oxygen is inserted into the neck of the balloon. The oxygen is soon seen burning in the vapour of sulphur which fills the vessel; the product of combustion, viz. sulphur dioxide, is led by the second tube into the water in the cylinder, the presence of sulphurous acid in which is easily exhibited (C. von Tham, *loc. cit.*).

B. *Burning Sulphuretted Hydrogen in Vapour of Nitric Acid.*—60 to 80 c.c. of concentrated nitric acid (sp. gr. 1·53) are placed in a flask of 500 c.c. capacity. A rapid stream of sulphuretted hydrogen is passed, through water, into the acid, whereupon red fumes are copiously produced. The delivery tube is slowly raised from the surface of the acid towards the neck of the flask; at a certain distance from the acid the sulphuretted hydrogen takes fire and burns with a blue flame; the upper part of the flask becomes filled with white fumes of sulpuric acid, the lower part with red fumes of oxides of nitrogen, little or no sulphur separating (Kessel, *Berichte*, xii. 2305).

C. *Burning Ammonia in Oxygen.*—A wide-mouthed flask is fitted with a cork, which carries a tube passing nearly to the bottom of the flask, and also a large straight drying tube, which contains solid caustic soda and is closed at its upper end by a cork carrying a little piece of tubing drawn out to an opening about 2 mm. in diameter. A quantity of strong ammonia liquor is placed in the flask and heated nearly to boiling, the lamp is withdrawn, and the cork with its tube inserted. A stream of oxygen is passed into the hot liquor, and the dry ammonia, mixed with oxygen, is ignited as it issues from the caustic soda tube. As the amount of ammonia diminishes, the flame becomes smaller, but very hot; a piece of platinum wire may be melted, or a lime cylinder may be caused to give out much light, by holding it just above the central zone of the flame (Rosenfeld, *Berichte*, xiv. 2104, and xv. 169.)

D. *To show that Water is produced by Burning Hydrogen in Oxygen.*—A small platinum flask (as is figured in Roscoe and Schorlemmer's "Chemistry," I., p. 339) is furnished with a good cork carrying two tubes of ordinary pipe-clay, which reach towards the bottom of the flask: one of these tubes communicates by caoutchouc tubing with a supply of dry hydrogen, the other with a supply of dry oxygen. The exit-tube of the flask is attached to a piece of glass tubing which connects with a glass worm condenser, underneath which a beaker is placed. Dry hydrogen is passed into the flask until the air is completely replaced from the entire apparatus: while this is being done, the caoutchouc tubing which connects the clay tube with the oxygen supply is securely clamped just above its junction with the clay pipe, to prevent hydrogen from diffusing backwards into the oxygen tubes, and so forming an explosive mixture. When the air is all driven out of the apparatus, the platinum flask is heated to redness, dry oxygen is passed into it, and the lamp is withdrawn. By properly regulating the streams of oxygen and hydrogen, so much heat is produced that the flask becomes nearly white hot; water is quickly formed and trickles, and after a little, flows in a continuous stream through the glass worm into the beaker beneath (Hofmann, *Berichte*, xii. 1122).

E. *Unburning of Water-gas by Iron and by Magnesium.*—3-4 grams very finely divided iron (*Ferrum alcoholisatum*) are placed in a small piece of hard glass tubing about 12 cm. long and 14 mm. diameter. One end of this tube is connected with a flask containing hot water, the other with an ordinary gas exit-tube and small pneumatic trough. The iron is heated, the water brought to, and just maintained at the boiling-point, and the end of the delivery-tube is plunged under the water in the trough. Hydrogen is obtained in a rapid stream. As thus arranged the decomposition of water-gas by iron is readily shown without the use of a furnace or porcelain tube.

A similar apparatus serves to show the decomposition of water-gas by magnesium; a piece of magnesium-ribbon about 60 cm. long is folded on itself so as to form a bundle about 1 cm. in length, which is placed in the glass tube; the water is kept nearly boiling; the magnesium is heated until it begins to melt and burn at the edges, at this moment the water is rapidly boiled (and the exit-tube is plunged under the water in the trough), when the magnesium is found to burn vividly in the steam and hydrogen to be evolved in quantity (Rosenfeld, *Berichte*, 15, 160.

M. M. P. M.

NOTES

WE are glad to learn that one of the evening (Friday, August 25) discourses at the Southampton meeting of the British Association will be given by Sir William Thomson, and that the subject will be "Tides." Prof. Moseley's discourse on "Pelagic Life" will be given on Monday evening, August 28.

THE honour of Companion of the Order of St. Michael and St. George has been conferred upon Mr. W. T. Thiselton Dyer, F.R.S., Assistant Director of the Royal Botanical Gardens, Kew, for services rendered to Colonial Governments.

THE FRENCH Minister of Public Instruction has again appointed a Commission to direct the deep sea exploration of the Atlantic in the *Travailleur* in July and August next; the investigation will include the ocean bed along the coasts of Spain, Portugal, and Morocco. The members of the Commission are MM. A. Milne-Edwards, L. Vaillant, E. Perrier, Marion, Folin, and P. Pischer.

A FLORENCE correspondent writes:—"On Sunday, May 21, the students and professors of the Faculties of Science and Medicine of Florence assembled to celebrate the memory of Charles Darwin. The large aula of the "Istituto" was crowded with auditors, and many had to be content with standing-room in the corridor outside. An address was read by the representative of the students, and an eloquent study of the genius and character of the great man of science by Prof. Mantegazza. I was struck by the note of religious solemnity that marked the proceedings." Similar testimonies of the high veneration in which the name of Darwin is held abroad come to us from other parts of Italy, as well as France, Germany, Norway, and Russia.

WE lately noticed the death of Mr. T. Donovan, lecturer on physiology and other scientific subjects at the Working Men's College and at the Birkbeck Institution. We learn that he has left a widow and two children, whose position has excited the sympathy of some of those who know the value of the work he did, and that a committee has been formed to collect a fund for their assistance. Mr. R. B. Litchfield, Bursar of the Working Men's College, whose address is 4, Bryanston Street, Portman Square, W., is Treasurer of the Fund.

Messrs. Hachette and Co. have just published two "map-size" chromo-lithographic plates of the "Phylloxera de la Vigne," one of which illustrates the habits of the insect, whereas the other represents it in its varied stages and conditions. They are especially suitable for the lecture-room, and their distribution in some of our colonies might serve to nip unnecessary panic in the bud. All the figures are enormously enlarged, and highly (perhaps a little *too* highly) coloured, with full explanatory text.

Miss Ormerod's "Reports of Observations on Injurious Insects during the year 1881" (W. Swan Sonnenschein and Co.) is far more bulky than its predecessors. This is mainly due to a lengthy and valuable series of reports on the Turnip Fly, which we commend to the notice of all who are likely to be directly influenced by this pest. Other old friends (?) receive their usual share of attention. Miss Ormerod was recently appointed honorary consulting entomologist to the Royal Agricultural Society.

The following is the programme of the Davis Lectures on zoological subjects which will be given in the lecture-room in the Zoological Society's Gardens, in the Regent's Park, on Thursdays at 5 p.m., commencing June 8:—June 8, Armadillos, living and extinct, by Prof. Flower, LL.D., F.R.S.; June 15, the British Lion, by Prof. Boyd Dawkins, F.R.S.; June 22, Crocodiles, by Prof. Parker, F.R.S.; June 29, British Snakes and Lizards, by Prof. Mivart, F.R.S.; July 6, Frogs and Toads, by W. A. Forbes, B.A.; July 13, Insects and their Metamorphoses, by Prof. Martin Duncan, F.R.S.; July 20, Foreign Zoological Gardens, by P. L. Sclater, M.A., F.R.S.

We are glad to notice that the Principal of the Royal Agricultural College at Cirencester has supplemented the teaching of biology in that institution, by establishing a thoroughly equipped and efficient biological laboratory. One of the largest and best lighted rooms in the college has been devoted to this purpose, and under the direction of Prof. Harker, has been furnished with dissecting tables and apparatus suited to modern requirements for the effective teaching of the subject. A number of microscopes have been provided; and practical demonstrations in the laboratory now form a necessary part of the course. The students are afforded every opportunity of acquainting themselves with the methods of microscopic manipulation. A special collection of types and a reference library in biology are to form part of the new institution. In view of the growing importance of biology in relation to agriculture, we think this is a wise step in the interests of the student.

According to the *Golos* correspondent at Singapore, M. Miklukho Maclay was at that place on April 10, on his return from Australia and on his way home. But his visit home is to be short, as he expects soon to return to Australia, where he has left his large collections. His health is very bad in consequence of continuous fever and neuralgia, and notwithstanding his being only thirty-seven years old, he looks an old man. His twelve years' travel, accompanied with all possible privations, has broken his health. It is to be feared therefore that the publication of the results of his journeys and the description of his extensive collection will be considerably delayed.

In the Scandinavian Exhibition now being held at South Kensington, there is a very fine and complete collection of objects in prehistoric archæology.

We have received the second part of the "Descriptions of new Indian Insects from the Collections of the late Mr. W. S. Atkinson," by Mr. Frederic Moore (published by the Asiatic Society of Bengal). The remarks that have already appeared in Nature, concerning the first part, apply equally to this, and we defer a longer notice until the completion of the work.

"Human Morphology" is the title of a work in three volumes, by Mr. H. A. Reeves of the London Hospital, the first volume of which Messrs. Smith, Elder, and Co. will immediately publish.

The Göttingen Royal Society of Sciences have announced the following subject for prize competition (Beneke-foundation): Comprehensive researches are desired on the microscopical, that is, the anatomical and micro-chemical structure of vegetable protoplasm. The two prizes offered are about 85*l.* and 34*l.* respectively. Papers, written in German, Latin, French, or English, to be sent in in the usual way, before August 31, 1884. The prize award takes place on March 11, 1885.

The Ben Nevis and Fort-William meteorological observations will be recommenced to-day by Mr. Clement L. Wragge, under the auspices of the Scottish Meteorological Society. A new fixed station is to be established near the lake, about 1,840 feet above the sea, the observations made at which, together with additional observations by means of travelling instruments at certain fixed hours and places to be taken during the ascent and descent, will the better enable atmospheric disturbances existing in the stratum of air between the summit of Ben Nevis and Fort-William to be observed, and discussed with some fulness. The hours of observation at Fort-William will be 5 a.m., 6 a.m., 7 a.m., 8 a.m., 8.30 a.m., 9 a.m., 9.30 a.m., 10 a.m., 10.30 a.m., 11 a.m., 11.30 a.m., noon, 1 p.m., 2 p.m., 3 p.m., 6 p.m., and 9 p.m. The observations to be taken on the journey to Ben Nevis will be 6 a.m. on the peat moss, 7 a.m. at the lake, 8 a.m. about 300 feet, and 8.30 a.m. at Buchan's Well. On the summit of Ben Nevis, Mr. Wragge will observe at 9 a.m. 9.30 a.m., 10 a.m., 10.30 a.m., and 11 a.m. During the descent, or homeward journey, the observations will be at Buchan's Well at 11.30 a.m., about 300 feet at noon, at the lake at 1 p.m., and on the peat moss at 2 p.m. Thus all these observations will be simultaneous with those taken at the low level station at Fort-William. Specially constructed thermometers to record the temperature by clockwork on the top of Ben Nevis at 9 p.m. have been most kindly placed at Mr. Wragge's disposal by Messrs. Negretti and Zambra, London. The indications of these instruments at that hour on the Ben will be of especial value to meteorologists, since the means of temperature and humidity at 9 a.m. and 9 p.m., the observing hours adopted by the English and Scottish Meteorological Societies, will thus be obtained for the top of the Ben. Mr. John Browning, of the Strand, London, has kindly presented a rain band spectroscope, to be used in the Ben Nevis investigations, from the use of which, in the hands of Mr. Wragge, valuable observations bearing on weather forecasting may be expected. Dr. R. Angus Smith, F.R.S., Manchester, has generously undertaken to supply apparatus for measurement of the actinism of the sun's rays and of daylight; and it has further been arranged that a very complete system of ozone observations at the foot, on the slopes and top of the Ben shall be carried out. The ordinary observations on Ben Nevis, at Fort-William, and at intermediate points will be of atmospheric pressure, temperature of the air, earth, lochs, and wells, direction and force of wind, kind, and amount of cloud, movements of the various strata of cloud, rainfall, ozone, and optical phemena. Additional rain gauges will be fixed on the summit of Ben Nevis to ascertain if the rainfall is the same with various winds at different points of the plateau, particularly from near the edge of the tremendous cliffs inward over the plateau. The work of arranging and opening the stations has already been commenced, and Mr. Wragge will doubtless have the entire system in full working order by 9 a.m., June 1, as stated above.

We learn from *Naturen* that the authorities at Washington have availed themselves of the presence in the capital of Herr L. Stejneger, of Christiania, to secure the services of this eminent

Norwegian naturalist to conduct a scientific mission to Kamchatka. At two days' notice, Herr Stejneger started, on March 22, well supplied by the U.S. Signal Service Department with all the instruments and appliances necessary for carrying out his instructions which emanate conjointly from the Smithsonian and the U.S. Meteorological Institutions. A year and a half has been suggested as the term of his mission, but in this, as in other matters, he is left to follow his own judgment in regard to the best way of attaining the objects it is proposed to secure. These are: (1) the erection of a meteorological station, of the first class if possible, on the coast of Kamchatka, and one of the second or third class on Behring Island, and at Petropawlovsk, for each of which he is to make arrangements that will secure their permanent efficiency after his departure; (2) in the capacity of a member of the U.S. Fish Commission, to draw up a report of the fishing-grounds, more especially with reference to the condition of the cod-fisheries; (3) to collect, for the national museum the largest attainable number of the remains of the now extinct Rhytina, or Arctic sea-cow, good skins of *Phoca leonina*, *Otaria ursina*, and other sea-animals, together with a few skeletons and a large number of the crania of these and other marine mammals, and of the local birds and fishes. Herr Stejneger promises to keep the readers of *Naturen* acquainted with the success that may attend him in the prosecution of his various and arduous labours.

WE are glad to observe that the telegraph is making rapid way in China. The Shanghai-Tientsin line has been working now for a few months, and a line is being constructed in the south between Canton and Hongkong—a distance of about 100 miles. The first section is to connect Canton, which is practically the commercial capital of China, with the frontier of British Kowloon, situated opposite the town of Victoria. After some consideration it has been decided that a land-line is preferable to a submarine cable, as it will be more economical, and the latter also would seriously interfere with the enormous junk traffic and fishing operations in the estuary of the Canton River. It is interesting to remark that this line is purely a private undertaking of a company of Chinese merchants in Canton, who, doubtless, want to be on a level with their brethren in the north, in rapidity of communication with the markets of the world. The line, as above stated, will for the the present terminate on the confines of British territory. It seems hardly credible—but the fact is stated in the Hongkong journals—that opposition is made by the British authorities to the further construction of the line, and especially to the cable across the harbour necessary to connect Kowloon with Hongkong unless it is constructed by a British company.

WE regret to see that the project of a meteorological observatory in Hongkong, which we have already described in NATURE, is still "under consideration." Major Palmer's very complete scheme, on which we commented at the time, was in the hands of the Colonial Office six months ago, but nothing has since been done, and there seems to be grounds for the fear that a work of much importance, local as well as general, for which funds are amply provided by the colonial authorities, will be postponed so long that the officer to whose knowledge and ability the scheme is chiefly due will have left the colony. It will be difficult and may be impossible to find a well-qualified substitute in a small community such as that of Hongkong.

THE Aëronautical Society of Great Britain propose to hold next year an exhibition similar to the one held in the year 1868 at the Crystal Palace, with the object of ascertaining the position of the science of aëronautics, and with the view of affording an opportunity to inventors to embody and exhibit the results of their labours. Several prizes will be offered, and an exhibit of balloons and all the appliances connected therewith will be invited; also of any methods for propelling a balloon or any gas vessel, influencing its direction, prolonging its life, improving its utility, &c. The Council will be glad to have an intimation addressed to the secretary, from members or others, that they are likely to exhibit, or to assist in raising the funds which will be necessary to carry out the project.

IT has been decided by the Chancellor of the Upsala University to purchase the botanical collection belonging to the famous Swedish botanist, the late Prof. Elias Fries, for a sum of 1250*l.*; the collection, however, does not include a Scandinavian Phanerogam herbarium, a collection of mosses and algæ, as well as some other objects, which have been purchased by some one, who desires to be unknown, and presented to the Botanical Museum in Upsala.

THE Swedish Diet has voted a sum of about 300*l.* towards a geological expedition to Spitzbergen in the summer of 1883, which amount will be placed at the disposal of the Academy of Science in Stockholm; it is, however, stipulated that all objects collected shall be presented to the National Museum.

INTELLIGENCE from the island of Fayal, one of the Azores, states that a violent earthquake occurred there on May 3. The shocks continued during an hour, in which time churches, public buildings, and several houses were destroyed.

AFTER efforts to domesticate several species of wild ducks in America, capturing them young, or raising them from the eggs, Mr. Lindon says (Buffalo Soc. Nat. Sci.) that none adapted themselves thoroughly to the barnyard state except the mallard, dusky duck, and Canada goose, whose progeny prospered well, and attained a greater weight and size than the ordinary domesticated stock. Some of them betray a tendency to revert in plumage, to their original condition, but the majority have been completely metamorphosed into the ordinary barnyard fowl. No hybrids from any two different wild species, which bred only within the inclosure, were ever obtained, except from crosses between the mallard and dusky duck. The mallard has been supposed to be the originator of the common tamed ducks, but the dusky duck is now pronounced to be fully as domesticable.

IN view of the vagueness of expression "rainy day" in meteorology, Prof. Schmeltz has lately devised an apparatus to register the actual duration of rain. (He was not aware of M. Redier's apparatus for this purpose). From a description in the *Journal de Physique* (May), we learn that a long band of Morse paper sensitised for rain is used. The paper is dipped in a solution of sulphate of iron, dried carefully, and coated with tannic acid, or pulverised ferrocyanide of potassium, mixed with powdered resin for better adherence. The strip is stretched between rollers, one of which is actuated by means of an endless chain from a toothed wheel on the axle of the minute hand of a common clock. It passes under a funnel in the top of a wooden case, which is open below and is fixed outside a window. By means of guide rollers it receives double inclination (longitudinal and transverse), and the rain in excess does not sensibly spread beyond the part passing under the funnel. The length which the rollers transfer during a whole day is divided into twenty-four equal parts, each corresponding, on an average, to an hour. When no rain has fallen during the day, the paper strip used may be utilised again, being easily wound on the delivering roller. This simple and cheap apparatus is said to act admirably.

A WELL-ARRANGED and instructive Popular Handbook to the Natural History Collection in the Museum of the Yorkshire Philosophical Society, has been issued by the keeper, Mr. Walter Keeping.

THE Council of the Society of Telegraph Engineers and of Electricians have determined that the Society shall offer three premiums annually for the best original papers sent in to the Society on Telegraphic or Electrical Subjects during the Session by any person not being a member of the Council of the Society. The 1st Premium will be called the Society's Premium, value 10*l.*; 2nd, the Paris Electrical Exhibition Premium, value 5*l.*; 3rd, the Fahie Premium, value 5*l.* The Premiums will consist of books or scientific apparatus. The first Premium will be awarded in 1883 for the best papers sent in between this date and the end of May next.

DR. F. A. FOREL, of Morges, informs us that the supposed lacustrine canoe referred to in NATURE, vol. xxvi. p. 67, was really a simple trough made out of a log, for the reception of spring water.

THE additions to the Zoological Society's Gardens during the past week include a Spotted Cavy (*Cœlogenys paca*) from South America, presented by Mr. V. Gibbs; a Red Brocket (*Cariacus rufus* ♂) from Trinidad, presented by Mr. H. Sandbach; a Black-breasted Sparrow (*Passer diffusus* ♂), a White-throated Seed Eater (*Crithaga albogularis*) from South Africa, presented by Mr. J. Abrahams; a Horned Lizard (*Phrynosoma cornutum*) from Texas, presented by Capt. E. C. B. Walker; three Midwife Toads (*Alytes obstetricans*), fourteen Alpine Newts (*Triton alpestris*) from Belgium, presented by M. G. A. Boulenger; a Lesser White-nosed Monkey (*Cercopithecus petaurista* ♀) from West Africa, a Jackass Penguin (*Spheniscus magellanicus*) from the Falkland Islands, two Cape Crowned Cranes (*Balearica chrysopelargus*) from South Africa, a Flamingo (*Phœnicopterus antiquorum*) from North Africa, two Bernicle Geese (*Bernicla leucopsis*), two White-fronted Geese (*Anser albifrons*), a Ruddy Sheldrake (*Tadorna rutila*), a Herring Gull (*Larus argentatus*), European, a Bordeaux Snake (*Coronella girondica*), South European, deposited; a Koala (*Phascolarctos cinereus*) from Australia, two Javan Peafowls (*Pavo spicifer* ♂ ♀) from Java, purchased; a Collared Fruit Bat (*Cynonycteris collaris*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

THE COMET.—The following orbit of the present comet has been calculated by Mr. Hind, from observations at Harvard College, U.S., on March 19, Josephstadt (Vienna) on April 19, and one by Prof. Millosevich, at the Collegio Romano, Rome, on May 21; parallax and aberration were taken into account:—

Perihelion passage, June 10·52442 Greenwich M.T.

	°	′	″	
Longitude of perihelion	53	55	18·0	From M. Eq., 1882·0.
,, ascending node...	204	53	56·9	
Inclination...	73	46	39·8	
Log. of perihelion distance ...	8·782864			

Motion—direct.

From these elements we find the positions near perihelion passage thus—

			R.A.		Decl.		Distance from Sun's centre.				Intensity of Light.
							In R.A.		In Decl.		
	d.	h.	°	′	°	′	°	′	°	′	
June	10	0	74	58·4	+23	41·9	−3	33	+0	40	82·6
	10	6	75	50·8	+22	34·5	−2	56	−0	29	104·5
	10	18	78	0·2	+20	29·2	−1	18	−2	36	105·2
	11	0	79	16·1	+19	40·4	−0	17	−3	26	87·6

The intensity of light on May 21 has been taken as unity. The comet was then judged to have the brightness of a star of 5·6m. On May 18 Mr. G. Knott estimated it a little higher than 6·0, which fairly accords. Whence theory would raise it to over an average first magnitude at perihelion. With due precautions which will occur to most observers who have large refractors, it is now seen to be by no means improbable that the comet may be observed in full daylight, on June 10 and 11. Still it may be well to remark that as compared with the first comet of 1847, observed at noon, close to the sun, on March 30, by Mr. Hind, with a 7-inch refractor, stopped down to about 3 inches, the theoretical intensity of light at perihelion is not quite half as great; thus calling the brightness unity when the comet was first glimpsed with the naked eye, the brightness of the present comet at perihelion will be 186, while that of the comet of 1847 was 408.

By the above orbit the comet traverses the plane of the ecliptic at the ascending node 0·038 within the earth's track.

DOUBLE STARS.—No. 6 of "Publications of the Cincinnati Observatory" has been issued. It contains micrometrical measures of double stars made with the 11-inch refractor in 1879-80, consisting partly of observations preliminary to the formation of a general catalogue of known double stars situated between the equator and 30° south declination, and partly of observations of objects which Mr. Burnham has found to need re-observing. The cases of notable differences from previous measures are collected in the introduction. Mr. Ormond Stone is doing excellent work with his refractor, which appears to have been much improved since the object-glass was re-figured by Messrs. Alvan Clark and Son.

THE VARIABLE STAR U GEMINORUM.—Mr. G. Knott, writing from Cuckfield on May 29, states that he had caught a maximum of this apparently capricious variable on May 27 or 28; on both nights it was about 9·9 m. This, compared with the previous maximum noted by the same observer on February 28, gives a period of eighty-eight days.

Prof. Schönfeld finds that a star R.A. 16h. 13m. 36s., Decl. − 7° 21′·0 for 1855 is variable.

A star in R.A. 19h. 17m. 33s., Decl. − 21° 32′·3 for 1850, must be variable to a great extent—6·5 to 9·0 at least.

TEMPERATURE REGULATORS

BEFORE proceeding to the consideration of some of the means adopted for controlling temperature, more or less perfectly, it will be as well to notice two instruments, because although they are in reality only indicators, yet the latter is always referred to as a regulator.

Hall's aërometer[1] consists of a glass bulb 4½ c.i. in capacity, attached to a long tube whose capacity is 1 c.i. This tube is inserted into another of nearly equal length, and supported on a stand. The first tube admits of being sustained within the second at any given height by means of a spring. The outer tube is charged with mercury or water, according to circumstances, and the bulb and inner tube are arranged to contain, at the normal pressure and temperature, 5 c.i. of air. Any changes, therefore, in the atmospheric conditions will affect the level in the inner tube, and can be allowed for accordingly.

Doyere's regulator[2] (1848), which is on the same principle, consists of a glass bulb, to the bottom of which a fine tube is attached. This tube is bent, then carried upwards for a certain distance, is then bent again to form an inverted U-tube, the extremity is again bent upwards, and terminates in an open bulb. The lower bulb and the quill-tube are partly filled with water, the surface of which in the tube indicates by its change of position the alterations in the volume of the air contained in the bulb. The principle on which Fresenius' cast-iron drying-disk is constructed is the same which long ago led to the use of sand-baths, for it is obvious that if a large mass must be warmed before the heat can reach the substance, a rapid rise in temperature is impossible. The number of substances which can be conveniently dried at the temperature of boiling water, and the number of chemical operations which require that temperature, have led to the construction of every variety of water-bath and water-oven. With a temperature not much above the boiling point of water, the increase may be obtained by using solutions of various salts; but with these the evils of bumping and crystallisation are so great that Sprengel (1869)[3] replaced the water in a water-oven by sulphuric acid having a specific gravity of 1·55, and for that purpose constructed a leaden one of the following description: The outside case of the double-walled air-bath is a 6½-inch cube, the inside a 5-inch cube. The worm, made of about 30 feet of leaden piping of ⅜-inch diameter, is 15 inches high and 4 inches wide. The coils of the worm are kept apart from each other ⅛ inch by means of solder, and the worm is kept in its upright position by two iron supports soldered to the sides of the air-bath.

Laspeyres[4] (1874), using the same liquid, constructed two pieces of apparatus. One was a glass flask so arranged that

---

[1] *Q. J. Sci.* v. 52 (1818) Faraday's manip. 375.

[2] *Ann. Chim. Phys.* [3] xxviii. 5 (1850) Gerhardt 1,105.

[3] *Journ. Chem. Soc.* xxvi. 458 (1873).

[4] *Pogg. Ann.* clii. 132 (1874).